

RECEIVED
CENTRAL FAX CENTER

JUN 23 2009

U.S. Patent Application Serial No. 10/528,137
Response to OA dated October 2, 2008

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (Currently Amended): A substrate processing apparatus comprising:
a reaction furnace for processing a substrate;
a seal cap for sealing the reaction furnace hermetically;
a cover formed by a plate-shaped member and installed separately from the seal cap so as to cover approximately the entire surface of the seal cap facing the inner side of the reaction furnace;
a small chamber formed at least by a space enclosed by the seal cap, [[and]] the cover and the inner wall surface of the reaction furnace;
a feed opening facing the small chamber for supplying a first gas that is inert to the seal cap to the small chamber;
a flow outlet provided in the small chamber formed by a clearance between the cover and the inner wall surface of the reaction furnace, for making the first gas supplied to the small chamber flow into the reaction furnace; and
a feed opening provided further downstream than the flow outlet, for supplying a second gas that is more active to the seal cap than the first gas into the reaction furnace.

Claim 2 (Cancel)

U.S. Patent Application Serial No. 10/528,137
Response to OA dated October 2, 2008

Claim 3 (Currently Amended): The substrate processing apparatus according to claim 1 [[2]], wherein the reaction furnace includes a process tube, and a furnace opening flange for supporting the process tube; and the small chamber is formed by a space enclosed by the seal cap and the cover and the inner wall surface of the furnace opening flange; and the flow outlet is formed by a clearance between the inner wall surface of the furnace opening flange and the cover.

Claim 4 (Currently Amended): The substrate processing apparatus according to claim 3, wherein the furnace opening flange includes an inlet flange for supporting the process tube, and a base flange for supporting the inlet flange; and the small chamber is formed by a space enclosed by the inner wall surface of the base flange and the cover and the seal cap; and the flow outlet is formed by a clearance between the inner wall surface of the base flange and the cover.

Claim 5 (Original): The substrate processing apparatus according to claim 4, wherein the feed opening for supplying the first gas is provided in the base flange; and the feed opening for supplying the second gas is provided in the inlet flange.

Claim 6 (Cancel)

Claim 7 (Original): The substrate processing apparatus according to claim 1, comprising a boat for holding multiple substrates approximately horizontally at intervals in multiple stages, and

U.S. Patent Application Serial No. 10/528,137
Response to OA dated October 2, 2008

a rotation mechanism for supporting and rotating the boat by way of a rotating shaft penetrating through the seal cap, wherein the cover is installed in the rotating shaft.

Claim 8 (Original): The substrate processing apparatus according to claim 1, wherein the first gas is ammonia, the second gas is dichlorosilane, and a silicon nitride film is formed on the substrate by the thermal CVD method in the processing.

Claim 9 (Withdrawn): A substrate processing apparatus comprising:
a reaction furnace for processing a substrate;
a seal cap for sealing the reaction furnace hermetically;
a first cover installed separately from the seal cap so as to cover at least a section of the surface of the seal cap facing the inner side of the reaction furnace;
a first small chamber formed by the seal cap and the first cover, a first feed opening for supplying a first gas to the first small chamber;
a first flow outlet provided in the first small chamber for making the first gas flow into the reaction furnace;
a second cover installed separately from the inner wall surface of the lower section of the reaction furnace so as to cover at least a portion of the inner wall surface of the lower part of the reaction furnace;
a second small chamber formed by the second cover and the inner wall surface of the lower

U.S. Patent Application Serial No. 10/528,137
Response to OA dated October 2, 2008

part of the reaction furnace;

a second feed opening for supplying a second gas to the second small chamber; and
a second flow outlet provided in the second small chamber for allowing the second gas to
flow into the reaction chamber.

Claim 10 (Withdrawn): The substrate processing apparatus according to claim 9, wherein
a ring-shaped member is installed on the seal cap, the first small chamber is formed by the seal cap
and the first cover and the ring-shaped member; and the second small chamber is formed by the inner
wall surface of the lower part of the reaction furnace and the second cover and the ring-shaped
member.

Claim 11 (Withdrawn): The substrate processing apparatus according to claim 10, wherein
the first flow outlet is formed by a clearance between the first cover and the ring-shaped member;
and the second flow outlet is formed by a clearance between the second cover and the ring-shaped
member.

Claim 12 (Withdrawn): The substrate processing apparatus according to claim 11,
comprising a boat for holding multiple substrates approximately horizontally at intervals in multiple
stages,

wherein the reaction furnace includes a process tube comprised of an inner tube and an outer

U.S. Patent Application Serial No. 10/528,137
Response to OA dated October 2, 2008

tube, and a furnace opening flange for supporting the process tube; and

the first cover is comprised of an end plate on the lower side of the boat, and the second cover is comprised of an extending section of the inner tube extending downwards from the protrusion for installing the inner tube on the furnace opening flange.

Claim 13 (Withdrawn): The substrate processing apparatus according to claim 9, wherein there is no metal member inside the reaction furnace for mixing the first gas flowing from the first flow outlet with the second gas flowing from the second flow outlet.

Claim 14 (Withdrawn): The substrate processing apparatus according to claim 9, wherein the first feed opening for supplying the first gas is formed by a clearance between the seal cap and the rotating shaft.

Claim 15 (Withdrawn): The substrate processing apparatus according to claim 9, wherein the first gas is ammonia, and the second gas is dichlorosilane, and a silicon nitride film is formed on the substrate by the thermal CVD method in the processing.

Claim 16 (Withdrawn): A substrate processing apparatus comprising:
a reaction furnace for processing a substrate;
a seal cap for sealing the reaction furnace hermetically;

U.S. Patent Application Serial No. 10/528,137
Response to OA dated October 2, 2008

a first cover installed separately from the seal cap so as to cover at least a section of the surface of the seal cap facing the inner side of the reaction furnace;

a first small chamber formed by the seal cap and the first cover, a first feed opening for supplying a first gas to the first small chamber;

a first flow outlet provided in the first small chamber for allowing the first gas to flow into the reaction furnace;

a second cover installed separately from the inner wall surface of the lower section of the reaction furnace so as to cover at least a portion of the inner wall surface of the lower part of the reaction furnace;

a second small chamber formed by the second cover and the inner wall surface of the lower part of the reaction furnace;

a second feed opening for supplying a second gas to the second small chamber; and

a second flow outlet provided in the second small chamber for allowing the second gas to flow into the reaction chamber, and a third feed opening provided further downstream than the first flow outlet and the second flow outlet for supplying a third gas into the reaction furnace.

Claim 17 (Withdrawn): The substrate processing apparatus according to claim 16, wherein the first gas and the second gas are ammonia, and the third gas is dichlorosilane, and a silicon nitride film is formed on the substrate by the thermal CVD method in the processing.

U.S. Patent Application Serial No. 10/528,137
Response to OA dated October 2, 2008

Claim 18 (Currently Amended): A semiconductor device manufacturing method comprising the steps of:

loading a substrate into a reaction furnace;
sealing the reaction furnace hermetically with a seal cap;
processing the substrate by supplying a first gas that is inert to the seal cap from a feed opening facing a small chamber into [[a]] the small chamber formed by a space enclosed by the seal cap, the inner wall surface of the reaction furnace and a cover formed by a plate-shaped member installed separately from the seal cap so as to cover approximately the entire surface of the seal cap facing the inner side of the reaction furnace, along with making the first gas supplied to the small chamber flow into the reaction furnace from a flow outlet formed by a clearance between the cover and the inner wall surface of the reaction furnace provided in the small chamber, and supplying a second gas that is more active to the seal cap than the first gas into the reaction furnace from a second feed opening provided further downstream than the flow outlet; and
unloading the processed substrate from the reaction furnace.

Claims 19 - 20(Canceled)

Claim 21 (New): A substrate processing apparatus comprising:
a reaction furnace for processing a substrate which includes a process tube, an inlet flange for supporting the process tube, and a base flange for supporting the inlet flange;

U.S. Patent Application Serial No. 10/528,137
Response to OA dated October 2, 2008

a seal cap for sealing the reaction furnace hermetically;

a cover installed inside the base flange separately from the seal cap so as to cover approximately the entire surface of the seal cap facing the inner side of the reaction furnace;

a small chamber formed by a space enclosed by the seal cap, the cover and the inner wall surface of the base flange;

a feed opening facing the small chamber for supplying a first gas that is inert to the seal cap into the small chamber;

a flow outlet formed by a clearance between the cover and the inner wall surface of the base flange, for making the first gas supplied to the small chamber flow into the reaction furnace; and

a feed opening provided further downstream than the flow outlet, for supplying a second gas that is more active to the seal cap than the first gas into the reaction furnace

Claim 22 (New): The substrate processing apparatus according to claim 21, wherein the feed opening for supplying the first gas is provided in the base flange, and the feed opening for supplying the second gas is provided in the inlet flange.

Claim 23 (New): The substrate processing apparatus according to claim 21, wherein a ring-shaped protrusion is formed protruding to the inner side on the upper section of the inner circumferential surface of the base flange, and the cover is installed below the protrusion at a position with somewhat of a clearance.

U.S. Patent Application Serial No. 10/528,137
Response to OA dated October 2, 2008

Claim 24 (New): The substrate processing apparatus according to claim 23, wherein the outer diameter of the cover is smaller than the inner diameter of the base flange, and larger than the inner diameter of the protrusion.

Claim 25 (New): The substrate processing apparatus according to claim 21, wherein the cover is formed by a plate-shaped member.

Claim 26 (New): The substrate processing apparatus according to claim 21, comprising a boat for holding multiple substrates approximately horizontally at intervals in multiple stages, and a rotation mechanism for supporting and rotating the boat by way of a rotating shaft penetrating through the seal cap, wherein the cover is installed in the rotating shaft.

Claim 27 (New): The substrate processing apparatus according to claim 21, wherein the cover is arranged below the bottom of the boat and separately from the bottom of the boat.

Claim 28 (New): The substrate processing apparatus according to claim 21, wherein the first gas is ammonia, the second gas is dichlorosilane, and the processing is a processing for forming a silicon nitride film on the substrate by a thermal CVD method.